

Soil Evaluator Course
Chapter Three
GEOLOGIC DEPOSITS

There are eight broad groupings of geologic sediments (soil parent material) that occur within Massachusetts. Knowing the geology of a site is crucial to understanding how a site will impact adjacent areas and will help to narrow the focus of an on-site investigation to key issues.

GLACIAL TILL **Definition:** Dominantly unsorted and un-stratified debris deposited by a glacier, consisting of a heterogeneous mixture of clay, silt, sand, gravel, stones, and boulders.



Kinds: Two broad groupings of till:

1. Compact till also referred to as dense basal till or lodgement till
2. Loose, sandy till also referred to as ablation till

Compact-Till

Characteristics:

1. Wide particle size distribution: clay, silt, sand, gravel, cobbles, stones and boulders
2. Unsorted, heterogeneous mixture
3. Angular shaped rock fragments
4. Substratum, firm and compact (locally referred to as hardpan)
5. Relatively high percent clay (7 - 25%)

Associated Landforms:

1. Drumlin
2. Till ridge
3. Ground moraine

Focus of On-Site Investigation:

1. Verify presence of compact substratum. Field method for identifying compact till:
 - a. Note the ease of excavation by backhoe, a bucket often chatters across surface of compact till making shallow cuts with each pass.
 - b. Pick at the side of a test hole with a knife to feel for ease of penetration.
 - c. Squeeze a clod of soil between your thumb and index finger, initially compact till will resist crushing and then with increased pressure rupture suddenly.
2. Conduct perc test in the most limiting layer.
3. Check for the presence of a perched water table
4. Avoid construction during wet periods, may cause soil smearing and compaction
5. If several areas fail to perc and one passes, determine the extent of suitable material

Sandy, Loose Till (Ablation)

Characteristics:

1. Coarse textured, sandy, gravelly and stony
2. Typically loose, permeable material
3. VARIABLE, often has lenses or pockets of
4. Many stones and boulders
5. Small but significant amount of silt and clay

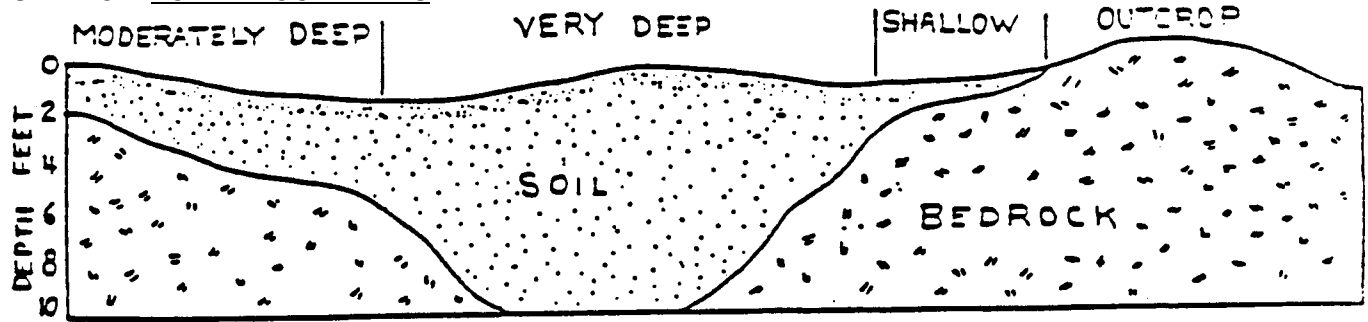
Associated Landforms:

1. Moraines: terminal and recessional
2. Ground moraine

Focus of On-Site Investigations

1. Determine variability and extent of soil conditions
2. Document any restrictive layers
3. Avoid construction during wet periods, smearing and compaction

SHALLOW TO BEDROCK AREAS



Complex soil *conditions* within a **shallow to bedrock** soil area.

Characteristics:

1. Variable, complex soil conditions, typically pockets of deep soil and areas of shallow to bedrock soils
2. Depth to bedrock often varies over short distances
3. Weathered or fractured bedrock can often be excavated easily but is not considered suitable material for a leaching facility
4. Rippable or non-rippable with an excavator

Associated Landforms:

1. Bedrock areas are not associated with any particular landforms
2. Typically bedrock areas are associated with irregular terrain, steep ridges, abrupt KNOBS
3. however, some areas of bedrock are nearly level to gently rolling with few outcrops of ledge.

Focus of On-Site Investigation:

1. Due to variable site conditions, the deep hole should be located in the exact location of the proposed facility
2. Maintain 4 foot separation of suitable soil material between leaching facility and bedrock surface
3. Fractured bedrock is not considered a suitable soil material and the depth to bedrock is the upper surface of the fractured zone.

Glacial Outwash

Definition: Stratified deposits of sands and gravel deposited by melt - water streams that flowed from melting glaciers.

Kinds: Two broad groupings of outwash:

1. Proglacial outwash - stratified outwash deposited in front of or just beyond the outer limits of a glacier
2. Ice-contact outwash - sands and gravel originally deposited adjacent to stagnant glacial ice that collapsed when melted leaving an irregular, often hilly terrain.

Proglacial outwash

Characteristics:

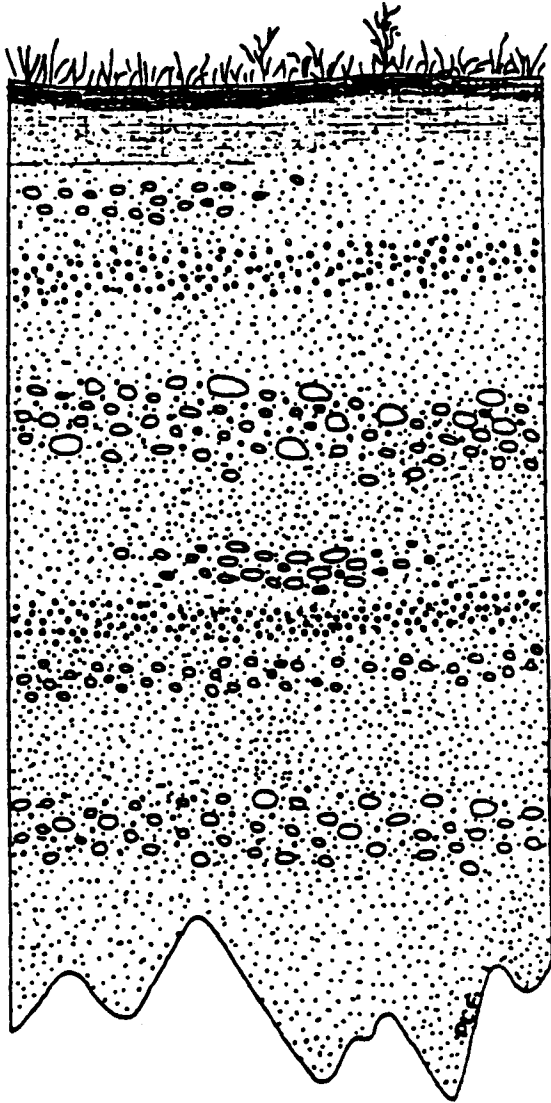
1. Stratified, well sorted material
2. Clean sands and gravel, typically with very little silt and clay
3. If present, gravel and cobble size rock fragments are rounded or sub-rounded
4. Loose material, walls of pit slough in
5. Generally lacks stones and boulders

Associated Landforms:

1. outwash plain

Focus of On-Site Investigation:

1. Rapid to very rapid perc rates
CAUTION - if areas of these soils are extensive and thick, they are groundwater recharge areas and may be underlain by aquifers. If a site is identified as being within an important natural resource area, additional testing may be needed to assess the threat of possible increased nitrate and phosphorous levels on groundwater quality
2. Conduct perc in the most limiting layer.



Ice-Contact Outwash

Characteristics:

1. Variable - conditions change over short distances, very
2. difficult to predict
3. Collapsed or slumped bedding
4. Well sorted to poorly sorted debris
5. Typically loose, sandy material but may include pockets or lenses of
6. silty material
7. Dirty feel, often contains *significant* amounts of silt and clay
8. May include areas of stone and boulders

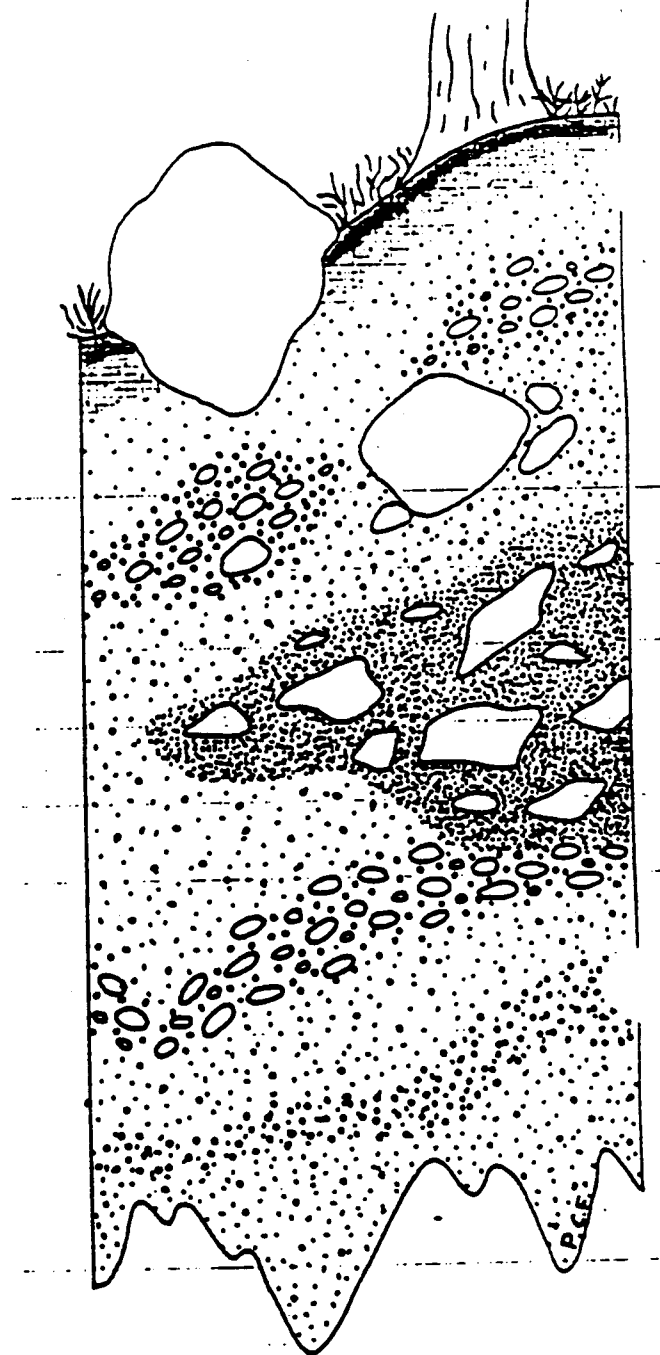
Associated Landforms:

1. Kames
2. Kettles
3. Eskers
4. Kame deltas
5. Kame terraces

Focus of On-Site Investigations:

1. Determine variability and extent of soil conditions
2. Document any restrictive layers

LAKEBED Sediments (LACUSTRINE)



Definition: Well sorted, fine textured sediments deposited originally at the bottom of glacial lakes, which has since drained.

Characteristics:

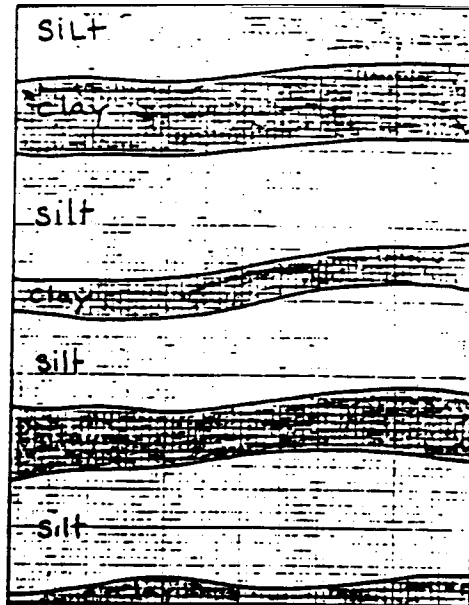
1. Well sorted, fine textured sediments
2. Generally high *content* of silt and/or clay
3. Rock fragments of gravel size and larger are typically absent

Associated Landforms:

1. Typically an undulating to rolling terrain and may have steep graded escarpments adjacent to water courses.

Focus of On-Site Investigation:

1. Typically slow to very slow perc rates
2. Check for vertical cracks in soils that may give erroneous perc rates
3. Very susceptible to smearing during wet periods
4. Poor internal drainage often causes these areas to be wet and have high seasonal water tables
5. Variable in some areas, particularly in old shoreline areas
6. Typically have thin layers of alternating silt and clay (varved) with the substratum.



MARINE SILTS and CLAYS

Definition: Areas of silts and clays deposited within a marine environment and have since been uplifted above present sea levels.

Characteristics:

1. Limited extent, only occurring in the Boston area and north, and only in those towns close to the coastline
2. VARIABLE - typically well sorted soils high in silts and clays
4. Locally referred to as blue clay

Associated Landforms:

1. Typically an undulating to rolling terrain, locally associated with land areas below certain elevations

Focus of On-Site Investigation:

1. Typically have slow to very slow perc rates
2. Very susceptible to smearing during wet periods
3. Poor internal drainage causes these areas to be wet and have high seasonal water tables
4. Variable within some areas

ORGANIC DEPSITS

Definition: Bog, swamp and marsh deposits comprised mostly of partially and well decomposed organic material.

Characteristics:

1. Weak strength, spongy sensation when walked across
2. Very dark color
3. Little to no mineral material, smooth creamy feel no grittiness
4. Formed in areas with a seasonal high water table at or near the surface

Associated Landforms:

1. Often within depressions and low lying areas adjacent to streams and lakes

Focus of On-Site Investigations:

1. These are wetland soil areas and should be avoided
2. Generally have a seasonal high water table at or near the surface for most of the year

COASTAL DUNE DEPOSITS

Definition: A natural hill, mound or ridge of sediment landward of a coastal beach deposited by wind action or storm overwash.

Characteristics:

1. Fine to coarse sands
2. Well sorted, often finely stratified
3. Little if no silt and clay, typically no gravel size or coarser rock fragments

Associated Landforms:

1. Ridges that often parallel the shoreline landward of the beach
2. Hills or mounds
3. Often have un-vegetated areas of loose sand

Focus of On-Site Investigation:

1. Ever-changing landscape, susceptible to coastal erosion by wave action and strong winds
2. A protected resource area, CAUTION - check reference materials to determine extent of area

FLOODPLAIN (ALLUVIAL) DEPOSITS

Definition: Material transported and deposited by present day streams and rivers.

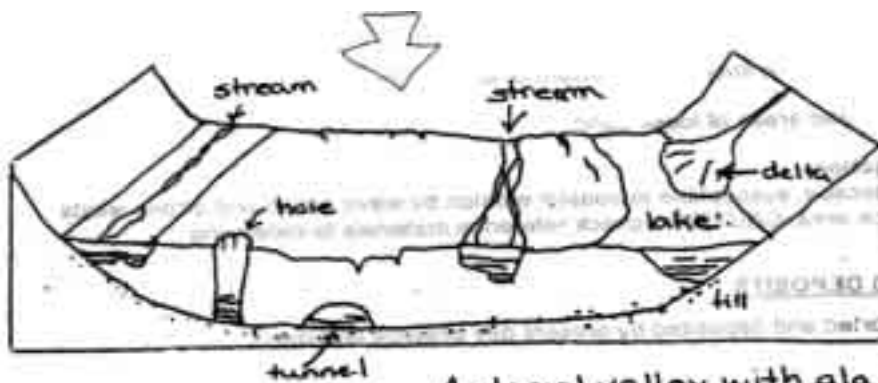
Characteristics:

1. Susceptible to seasonal flooding
2. Nearly level areas adjacent to large streams and rivers
3. Well sorted, often stratified
4. Fine textured, but may vary depending upon the velocity of the water
5. May have dark buried layers within the substratum that were at one time surface layers

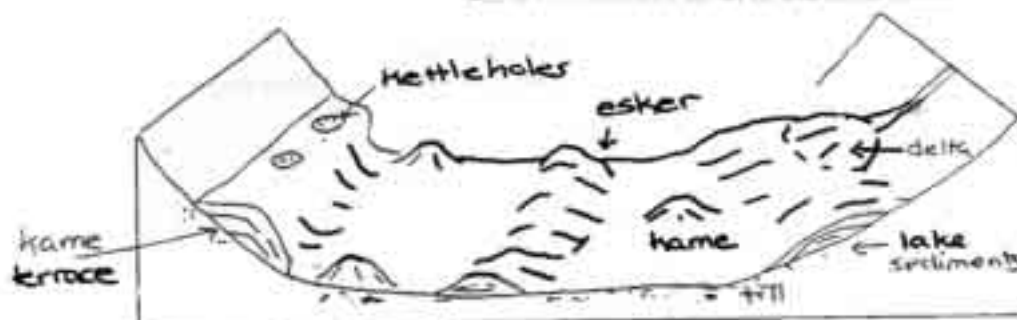
Associated Landforms:

1. Floodplain
2. Stream terrace
3. Oxbow
4. Meander scar





A glacial valley with glacier



A glacial valley after ice melt -

